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SCIENCE

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"CARBORUNDUM"; A SILICIDE OF CARBON.

BY WILLIAM R. BLAKE, NEW HAVEN, CONN., AND SHULLSBURG, WIS.

UNDER the name "carborundum," a new compound of carbon and silicon has been commercially introduced as an abrasive; a substitute for emery and corundum. It is a very hard crystalline solid, of a deep green color, and was obtained about the year 1890 by Mr. E. G. Acheson, of Chicago, while experimenting with the electric furnace with the intent of producing artificial diamonds. Under the supposition that he had obtained a compound of carbon and alumina he gave it the name "carborundum." Analysis,* however, shows the following composition:

Si	69.10
C.	30.20
Al_2O_3 and Fe_2O_3	0.49
CaO	0.15

Which may be expressed by the formula SiC; the other substances being regarded as impurities, and as imparting the color, which is found to be variable, from nearly white to a deep green and blue.

At a session of the Academy of Sciences of France, May 16, 1892, M. P. Schützenberger described the production of a new compound with the same formula.† It appears, however, that some carborundum had previously been molded into buttons and mounted in bulbs for electric lighting and exhibited by Mr. Nikola Tesla before the Institution of Electrical Engineers in London in the month of February, 1892, but its composition was not then known.

The value of this substance as an abrasive has led to its manufacture upon a large scale, and its introduction in the form of powders of different degrees of fineness, and of wheels and whetstones and polishing cloths.

The processes of manufacture are described in the memoir cited and also in another by the inventor,‡ which gives illustrations of the furnace, which consists merely of a rectangular box, about six feet long, eighteen inches wide and a foot deep, built up of fire brick, in which a mixture of sand and carbon is exposed to the electric current for eight hours. The result is a mass of crystals of small size, which is crushed, and the powder is digested with dilute sulphuric acid to remove impurities.

The crystallization has been carefully studied by Prof. B. W. Frazier, of Lehigh Univ., who finds it to be rhombohedral, and in some cases hexagonal. Both direct and inverse rhombohedra were observed and determined, viz.: 1-5, 4-5, 10-11, 1, 5-4, 4-3, 10-7, 2, 5-2, 4, 19-4, 5, 10.‖ In some crystals the direct and inverse rhombohedra of the same parameters were found on the same crystal, so as to impart to it an appearance of holohedral hexagonal symmetry.

The value for the length of the vertical axis is given as, $C = 1.2264$.

In the crystals which I have examined the tabular habit prevails, and as seen under the microscope they consist of hexagonal plates with the rhombohedral planes too small to permit of their inclination being measured.¶

The specific gravity of a bluish-green colored mass as determined by myself at 60 F. was found to be 2.946. Prof. J. W. Richards found it to be for the green crystals 3.123, and for the blue somewhat less.

The hardness, which is the most important character industrially, lies between the sapphire and the diamond, and may thus be expressed by 9½. It is claimed by the inventor that the powder on a rapidly revolving lap will cut and polish the diamond, and he believes that it may be advantageously substituted for diamond dust in diamond cutting.

It is a good conductor of heat, and is not fusible before the blow-pipe. It also resists all acids, even the fluoric, and does not burn when heated in a current of oxygen; this being one of the methods adopted to obtain it free of any graphitic carbon.

The color and lustre are remarkably brilliant, and if by any modification of the process large and solid crystals can be made, we shall have a valuable addition to our list of gems.

Considering the abundance of these two elements in nature, both silicon and carbon, and the comparatively indestructible nature of the compound formed by their union, it is surprising that we do not find this compound in nature. Its absence indicates the prevalence of conditions during the formation of the crust of the earth unlike those of the electric furnace.

* By Dr. Mulhaeuser, chemist of the Carborundum Company, in Memoir by E. G. Acheson: "Carborundum, Its History, Manufacture and Uses." Jour. Frank. Inst., Philadelphia, Pa., Sept., 1893.
† Contribution to the History of Carbo-silicious Compounds.
‡ Carborundum, etc., The Electrical Engineer, XV., p. 227, March, 1893.
‖ From a Report to the Carborundum Co., Memoir cited. Appendix, p. 19.
¶ Vide Article in Eng. Min. Jour., Sept., 1893.

LATTER-DAY TAXIDERMY.

BY VERNON L. KELLOGG, ITHACA, N. Y.

TAXIDERMY is hardly recognized as one of the fine arts, yet. Perhaps it may never be. But the truthfulness of representation, and the artistic effects of posing and grouping which "mounted" animals may exhibit, can often invest such work with an interest for those who may not be much inclined toward taxidermy for the sake of the skin-preserving. The displays of mounted birds and mammals at the World's Fair present several stages of progress in the art of taxidermy, and lead one to speculate on the outcome of it all. For scientific purposes, *sensu stricta*, the making of birdskins is probably preferable to attempting the mounting of the specimens; and so perhaps with many of the mammals. Evidently, however, if the specimen in hand can be truthfully represented so far as form and characteristic position and externals go, it may serve as a teaching object to many to whom the "made" skin, with accompanying written measurements, may be without a lesson.

But it seems as if it were possible to go even farther:

not only shall the restored animal act as a lesson in zoölogy, a reference object which may impress on the student-naturalist the peculiar characteristics of the animal species represented, but the restoration may possess the power of displaying the emotions and passions; it may be beautiful; it may, in a word, appeal to the human sense just as a figure in marble or bronze or staff may. The analogies, too, between sculpture and latter-day taxidermy, in matters of technique, are striking. The sculptor makes his model in clay, and often enough, now-a-days, is done with it.

Italian artisans are clever enough to carry on the work of reproduction even to the final touches on the marble. The man mounting an elk makes a model so complete in detail that the putting on of the skin does hardly more than add color and the effect of hair to his statue. A wooden frame, a rough wrapping of tow and twine, and over all the plastic clay giving truthful detail of form, and life, compose the model. The shapeliness of the limbs, with loose or swelling muscles, the rigid tendons, the sunken flanks, the projecting angles of the pelvic and shoulder girdles, the expressive lines of the eyes and nose and mouth, all exist in the model. Over this is drawn the skin, which fits because it does fit, and which is only a bit of realism added by the sculptor-taxidermist to his model. The traditional "stuffing" is truly a matter of tradition.

The taxidermist who is a naturalist and has thoroughly studied his subjects; who is an anatomist and is true, in his work, to structural detail; who has seen his animals walk and crouch and leap, not in cages alone, but in the forest and canon; and who perceives the look of fear or defiance, the attitude of cunning or of ferocity or of pain, and carries these expressions and poses ever in his eye, to be faithfully reproduced in his restoration, is equipped as the sculptor of animals must be equipped. And taxidermy by such a taxidermist comes near to being fine art.

Among the World's Fair displays of taxidermic work a notable one is that made by the University of Kansas, in the Kansas State Building. This building was planned with special reference to the displaying of this collection, and the arrangement adopted is an effective one. The collection comprises 109 mounted specimens of North American mammals, and contains several groups, as those of the Rocky Mountain Goats and the American Bison, of special value, from the zoölogist's point of view. But the rare excellence of the taxidermic work in this collection should attract a more general interest than that of the zoölogist alone. The work was done by Lewis L. Dyche, professor of zoölogy in the University of Kansas, and a majority of the specimens were personally obtained by him in a number of collecting expeditions. Some striking groups will repay critical study. In the fighting of two moose, the faithful adherence to anatomical detail, as shown in the contracted muscles, the carefully disposed limbs, and the skilful arrangement of the heads, is no more in evidence—in fact, at first glance is far less striking—than the artistic effect of the whole. The fury and extremity of exertion of the struggling animals is impressive. In a single magnificently-antlered elk the poise, the fine contour of the body, the speaking expression of the head and face are that of unconscious superiority. A snarling wolf has a head whose modelling is a work of genuine fine art. And the fine art of truth of detail is not neglected for the whole's effect. In the Art Galleries at the World's Fair there are many excellent pieces of animal sculpture, but a critical analysis will betray in some of them a woful ignorance of mammalian anatomy on the part of the sculptor, or a wilful distortion of it by him. For example, a reclining panther, with young, on the whole a fine piece, and singularly expressive, has the lower portions of the hind legs absurdly lengthened. Again, and often, the sculptor, to show that he really has anatomical detail in mind, has practically "skinned" his animals. A lion, in staff, at one of the entrances, and a panther, in bronze, within, are examples of this peculiarity. But in sculpture, probably, the effect is the primary intention; in taxidermy, truthful reproduction is the primary intention. Where, however, the mounted animal may not only be an object of scientific value as a truthful restoration, but may be possessed of the attributes of a work of fine art, the combination is a happy one. That such a combination is possible the writer believes some of Professor Dyche's animals prove.

NOTES AND NEWS.

"Inductive Psychology," by E. A. Kirkpatrick, is an outline of the science prepared for use in the author's classes in the State Normal School of Minnesota, and bears the imprint of Jones and Kroeger, Winona, Minn. It treats of the elements of the subject only, and some of them are so briefly dealt with that the book will hardly serve for those who study without a teacher; but for classes whose teacher is capable of expanding the hints that are plentifully scattered through the book it will be useful. It opens with a brief account of what psychology is and of the proper method of studying it, and then proceeds to treat first of the general powers of the intellect, consciousness and attention, and afterwards of the various special powers, such as perception, memory, etc. The author's expression is direct and simple, and, considering the smallness of the book, the elucidation of the various topics is remarkably clear. The views presented are, in the main, those that have stood the test of time; and we notice in particular that Mr. Kirkpatrick lays little stress on physiological methods, and apparently has little faith in their efficacy. On one point we are compelled to differ with him. He alleges in his preface that psychology has hitherto been taught deductively, and he seems to think that his own "inductive" method is something in great part new; but we have never seen a deductive psychology such as he speaks of, and we can see no essential difference between his method and that of previous writers. The best feature in the book is the numerous hints to teachers as to the best mode of studying the psychology of their pupils, a feature that makes the work specially available in the training of teachers.

—The translation of Windelband's "History of Philosophy," by Professor Tufts, of the University of Chicago, will be published about the third week of September by Messrs. Macmillan & Co. The advance sheets now ready indicate that the work will prove a valuable addition to available English records of the development of scientific conceptions of nature and human life. It will be published in one volume of about six hundred pages.

—Additional announcements of books to be published this fall by the Macmillans are: "Pain, Pleasure, and Æsthetics": An Essay Concerning the Psychology of Pain and Pleasure, with special reference to Æsthetics, by Henry Rutgers Marshall, M.A.; an annotated edition of the Adelphœ of Terence, by Prof. Sidney G. Ashmore, of Union College, Schenectady; a new edition with vocabulary and notes of Zupitza's "Old and Middle English Reader," upon the vocabulary of which Prof. MacLean, of the University of Minnesota, has been at work for some years, making it very complete and accurate; and a volume of "Chronological Outlines of American Literature," on the plan of, and uniform with, Mr. Ryland's "Outlines of English Literature."

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

CORN CANE.*

BY F. L. STEWART, MURRYSVILLE, PA.

IT IS the object of this paper to show from facts recently established that about one-half of the available food products of Indian corn are now wholly lost to us,—lost because unused and hitherto unknown to exist.

If it can be proved that what is thus lost can now be readily recovered, and not only so, but that it is recoverable as a new product from this plant, giving it an entirely new value, such attainable results will clearly be seen to be of great economic importance.

This consideration is entirely aside from the fact that much waste, which might be avoided, is often incurred in the production of our ordinary corn crop. Although great strides have been made within the past twenty-five years toward better farming in this country, by the adoption of improved implements and more systematic methods, it cannot be disguised that our treatment of maize, as an agricultural plant, is yet very defective, chiefly, as it seems, because its true nature and requirements are but imperfectly understood.

The tropical luxuriance of an American corn field, in the full tide of its summer growth, is something to awaken admiration: but the indulgence of such sentiment is commonly left to the artists and poets and the few students of vegetable physiology among us who have noted carefully the marvellous mechanical structure of the plant, its wonderful vigor and the perfect symmetry of its growth.

But all this goes for nothing at the harvest, when, in point of value, the dry, skeleton stalks are brought in contrast with the rich golden corn; and therefore the steady aim in cultivation has been to repress stem growth and increase the yield of grain.

No good reason is perceived why nature should so stubbornly persist in mounting the magnificent ears, which alone we set store by, upon solid culms twelve and fourteen feet high. And so, we have come to regard the huge stalks as the embodiment of much valuable constructive energy which might otherwise have been more profitably employed. True, this theory does not pass without protest; but it is satisfactory as shifting upon nature the responsibility for a condition of things which justifies the recent criticism of a surprised visitor out west, and complacently accepts it as true, that "Indian corn growing is the only business in which a man can waste forty-five per cent of his capital and yet make a living."

Certainly our appreciation of this plant and our treatment of it would be different if we knew it better. Our acquaintance with it is not yet of that intimate kind that we have with the cereals and forage plants that migrated with man from the cradle of the human race. It is true that maize has been known to civilized man, more or less, for about 400 years. Its grain is by far our most important food staple. Its production now equals about 2,000 millions of bushels annually in this country alone, in value, about 700 millions of dollars. Our agricultural system is, in a measure, shaped by the requirements of the successful growth of this crop, and we are credited abroad with knowing all that is worth knowing about it.

It has been introduced, also, into all regions of the earth where it can profitably be grown. In its already recognized relations to the welfare of man no acquisition from the vegetable kingdom has ever been found to equal it in value. Yet the obligation thereby implied to investigate thoroughly its nature and properties has most unreasonably been avoided by those competent to do it.

It has been taken for granted, apparently, that this plant has no uses beyond those already known. In this country, at least, its established rank among the cereals is so unique and unrivalled, and its capacity to supply all reasonable wants within what we have come to regard as its proper sphere, have seemed so complete as to awaken no desire for further investigation looking toward the discovery of any possible new uses of the plant or its growth and development under any other than the usual conditions.

Some ten years ago the writer of this shared with some others in the belief that both maize and the then newly introduced sugar millets or sorghums were entitled to a prominent place among sugar-producing plants for those regions of the temperate zones which are characterized by a sub-tropical summer climate. The experiments which seemed to justify such an opinion, however, were necessarily very incomplete, and covered a period of only about two years.

In the popular estimate of the comparative value of these plants the Cape millets or African varieties of sorghum were given the preference. This was also the view taken at the Department of Agriculture at Washington, to which, by special invitation of the Commissioner, the methods and results of some preliminary tests of mine were submitted for examination and report. It is outside of my present purpose to refer to those first experiments further than to say that they were repeated very successfully at the department by the chemist in charge and by others competent to do the work elsewhere, and the reports show that the conclusions first reached were abundantly confirmed.

In the years following experiments in sugar manufacture from sorghum began to be prosecuted under the patronage of the general government,—and of some of the State governments likewise,—and they have been continued with very variable results in different localities, but with the promise of permanent success, chiefly under the favorable climatic conditions prevailing in our southwestern States, especially Kansas and the Indian Territory.

The experiments being thus limited to sorghum alone, the value of maize in this connection was left entirely an open question. Practically, its claims were completely ignored.

What follows is simply a brief narration of work performed and of results reached in the course of an investigation begun and conducted throughout by myself in a private way to determine this question. It covers a

*An account of the results of an investigation concerning the value of Indian corn as a sugar-producing plant under new conditions of growth and development.

period of the last eight years, or from 1884 to 1892, inclusive.

The motive for undertaking it was furnished in the fact that in the previous examination of this plant I had noticed that it exhibited some remarkable peculiarities, the exact nature and causes of which were unknown, and to which no former investigation furnished any clue.

When it began, I had samples of different varieties of corn growing under different conditions as to soil and culture and planted at different times. In the course of tests made in the fall of the year 1884, the results of which were chiefly of a negative character, except as proving that the exceptional richness in sugar, which, in a few instances, had been noted before in some samples, did not attach to any particular variety of corn, and that the accumulation of sucrose or cane sugar in all sorts, both of field and sweet corn, was uniformly progressive with their growth after a certain period, and reached its supposed maximum always, as had previously been noted, just before the grain began to glaze or harden. In all sorts, likewise, the fact was confirmed that after that period had passed, vital activity in the plant almost immediately ceased, and all the soluble organized materials lodged within the cells of all parts of the structure, except the grain, rapidly ran down into lower forms successively, and in a few days totally disappeared, leaving in the stalk only a vapid watery juice, which in its turn as rapidly evaporated out. Of course, only the dead, dry stalk remained, in that condition a very type of worthlessness, except as a feeble support to bear up for a time the the ripened ear.

But it was noticed that some plants of the same age and sort as these shrivelled and dead ones, grown alongside of them in the same plot, from which, however, the immature ears had been plucked some time before, did not share in that condition. Their stems and leaves, and especially the leaves springing from the upper joints, were yet green and vigorous, and when samples of them were cut it was evident that they had not diminished in weight as compared with other plants cut before the grain had matured. Some of the juice was pressed out for examination, and to my surprise it showed qualities much superior to any previously noticed that season. These indications were more than confirmed when the sample was subjected to analysis. I give below the results of the tests to determine the relative percentages of the sugars and other solids contained in this juice, as taken from my note book at the date of this first experiment made upon maize in this condition, Sept. 10, 1884.

The variety was the common yellow Dent corn usually grown in this locality (western Pennsylvania).

	Sample Sept. 10, 1884. Specific gravity of juice, 1.071.	Sample Aug. 23, 1884. Specific gravity, 1.048.
Cane sugar, - -	13.84 per cent	6.70 per cent
Glucose, - -	1.07 " "	2.50 " "
Organic matter not sugar and salts,	2.39 " "	1.80 " "
Total solids, -	17.30	11.00

I have placed alongside of this for comparison, in the second column (above), the average composition of the juice of plants of the same variety, taken at the time when the grain was yet soft and when the cane sugar percentage was usually at its highest at that stage.

The experiment was speedily repeated upon another plant in the same condition and with almost precisely the same results. An increase of sucrose was indicated exceeding by nearly 100 per cent the normal as found in plants at the period of their life when it ordinarily has reached its highest limit.

This was a remarkable result in itself, but its chief significance seemed to rest in the fact that the high percentage of sugar was in some way correlated to the condition of arrested development of the grain.

Attention was at once directed to some naturally sterile plants, those upon which no ear had formed. These were still alive, green and vigorous, and closely resembled those from which the immature ears had for some time before been removed. Experiment soon disclosed an almost complete identity between them in the chemical composition of the juice. The only logical interpretation of this, supposing the results to be constant, was that the suppression of vital activity in the ear induces functional changes in other parts of the structure, especially in the stem in which the reserve products are chiefly lodged, whereby the existence of the plant is prolonged and a new direction given to the unspent energy which would otherwise have been consumed in the final development of the seed.

Taking only the totally abortive plants, abortive as to the seed, into the account, an analogue to them seemed to exist in the sugar cane, which produces ordinarily no seed at all. The relationship of the latter to Indian corn is very close. Was it possible that the arrested development of the seed, however brought about, conditions the more active building up and storage of the soluble carbohydrates, and especially cane sugar, within the cells of the stalk which seem so highly specialized for this end in both?

If so, it was hardly credible that such a circumstance should have eluded observation heretofore. Yet to that conclusion the facts so far gathered seemed to point.

If it could be fully verified as a physiological trait, under the specified conditions, it was easily seen that it would result in an enormous gain in the productiveness of the plant in two opposite directions, two full crops instead of one, the grain almost equal in amount and, superior in nutritive value to the ordinary hard corn, and instead of an almost worthless mass of dead fibre, fully developed canes, in full life and vigor, richly charged with true cane sugar.

It thus began to be evident that a new principle in the economy of the plant, unnoticed before, was in action, controlling its activities under the changed conditions.

The suggestion that the extraordinary accumulation of sugar in the juice was apparent only, and not real, the result simply of concentration by evaporation from the stem, had to be dismissed at once, for it is well known that true evaporation can take place only from dead cells, the process involving the destruction of their organized contents and not their accumulation, and is followed by immediate loss of weight.

Enough had now been learned certainly to stimulate to further research, but not enough to establish the absolute constancy of the new results reached under variously modified influences, all of which could not manifest themselves during a single season of growth. But if a thorough investigation during a series of years subsequent, covering all important points, should be found to confirm fully the outcome of these first experiments, it would be regarded as decisive. Nothing less would dissipate the incredulity with which a disclosure of the facts would be received when four hundred years of accumulated experience of the plant in cultivation, in every quarter of the world, had failed to bring it out.

To the self-imposed task of doing this work, self-imposed because neither inclination nor constraint seemed to impel any one else to undertake it, much of my time has been given during the past eight years.

In brief, it may now be said that the outcome has not only abundantly confirmed the conclusions first reached,

but shows that there can be no middle ground between the common estimate of the plant and that which a logical interpretion of all the facts now disclosed forces upon us.

Each successive season a fresh series of analyses and practical tests were made and put upon record, beginning with that stage of the development of the plant, when the percentage of cane sugar had previously been supposed to have reached its maximum, and extending them through the after period of juice-ripening, brought on by the timely separation of the immature grain, up to the time of frost. It was found that the saccharine strength of the juice, under the new conditions, constantly increased in a fixed ratio, and that the life of the plant was prolonged from a month to two months beyond the natural period.

(To be continued.)

THE ASTRONOMICAL EXHIBITS AT THE WORLD'S FAIR.

The Astronomical Exhibits at the World's Fair at Chicago represent fairly well the present state of the science of astronomy. But they are scattered about in the various buildings so as to make it difficult even to find them all, to say nothing of systematic study and comparison of them one with another. In a general way, the most important astronomical displays are to be found among the educational exhibits, which are located in the west and south galleries of the Manufactures and Liberal Arts Building. In the exhibit of Harvard University, in the south gallery, is a splendid collection of astronomical photographs made by the Harvard College Observatory. Especially interesting are several photographs of stellar spectra and of nebulæ and clusters. One photograph of a portion of the moon's disk represents an enlargement of over one thousand diameters. Nowhere else can be found a better illustration of the great usefulness of photography in astronomy. The collections of Draper and Langley are to be found in the exhibits of the University of the City of New York and of the Western University of Pennsylvania. The four-inch almacantar, which is the first one constructed and used by Dr. Chandler, is in the exhibit of De Pauw University. The exhibit of Johns Hopkins University contains a fine collection of diffraction gratings and photographs of spectra by Professor Rowland. In the German Educational Exhibit, in the west gallery, are specimens of the famous Jena optical glass, the original spectroscope of Kirchhoff, and some fine mathematical models by Brill. Here is also shown the magnetic apparatus of Gauss and Weber. Near by, in the English Exhibit, is the display of the Royal Astronomical Society, containing a large number of astronomical photographs by Roberts, Gill and Abney, and still others from the Royal Observatory at Greenwich. Boeddicker's drawings of the Milky-way and Dr. Common's five-foot glass speculum are in the English exhibit. The latter is unsilvered and has evidently been placed with greater care to secure safety than visibility. In the Swiss Exhibit, in the main aisle of the Manufactures Building, is a display of instruments by La Société Genevoise.

The exhibits of the American makers of astronomical instruments are in the north gallery of the Manufactures Building, just over the main aisle. Warner and Swasey show a fine twelve-inch equatorial telescope, with smaller instruments, and also the mounting of the great forty-inch Yerkes telescope, which is set up at the north end of the main aisle. The appearance of the great telescope gives an impression of symmetry and strength. The lens for it is being made by Alvan Clark & Sons, of Cambridgeport, Mass. They report satisfactory progress, but say that it will not be finished for a year or more. The Clarks, by the way, make no exhibit at Chicago. J. A. Brashear, of Allegheny, Pa., exhibits the stellar spectroscope for the Yerkes telescope. He also shows an eighteen-inch and a fifteen-inch objective, gratings, specula, etc. G. N. Saegmuller, of Washington, exhibits a variety of instruments of precision, among which are a nine-inch equatorial telescope and a four-inch steel meridian circle. The exhibit of the Gundlach Optical Company also deserves mention. The American instrument-makers, as a whole, make a most creditable showing. The displays of the foreign instrument-makers are, many of them, located in the Electricity Building. Schott und Genossen, of Jena, show a large number of specimens of optical glass, and among them are two twenty-three-inch discs of the celebrated Jena glass. Merz, of Munich, shows two equatorial telescopes and several telescopic objectives, the largest of which is ten inches in diameter. The Repsolds, of Hamburg, seem not to be represented—a fact much to be regretted.

Dr. Gill's interesting stellar photographs are in the Cape Colony Exhibit in the Agricultural Building, and the Lick Observatory display is in the educational department of the California State Building, and is strangely enough mixed up with the kindergarten exhibit there.

The U. S. Naval Observatory Exhibit is a small observatory located northeast of the Government Plaza, and is in charge of Lieut. A. G. Winterhalter, U. S. N. There are a small equatorial telescope, photoheliograph and many smaller instruments. The Weather Bureau Exhibit, a short distance to the west, is well worth a visit. The exhibit of Coast Survey apparatus, in the U. S. Government Building, is full of interest, from the geodetic standpoint.

SCIENCE TEACHING IN SECONDARY AND PRIMARY SCHOOLS.

DR. GEO. G. GROFF, LEWISBURG, PA.

It has long been a dream of scientists that the time would come when the elements of natural history and of the physical sciences would be taught in secondary and primary schools. To thinking people it does not seem necessary to argue that every boy should be instructed in the elements of chemistry, natural philosophy, botany, geology, zoölogy and physiology. To persons not teachers, it would seem no difficult matter to find a place in the school curriculum for the elements of the above sciences. But it remains true that they are not taught, or taught to such an extent, and in such a manner, as to produce results entirely worthless.

Why is this condition of things prevalent? Why, after all that has been said and written, is there is no change for the better? The answer seems to be this: The elements of the sciences are not taught in elementary and primary schools for the reason that the teachers themselves have never been taught, and without instruction they feel that to attempt to teach these branches they would be blind leaders of the blind. More than this, the schools whose special duty it is to train teachers for primary and secondary schools, have not begun to do any real work in the line of science instruction. The sciences in these schools are so placed in the background that practically no training at all is given in them. It is then no wonder that the graduate of such a school does not feel capable of giving any instruction in even the elements of the sciences. To demonstrate the above statements the catalogues of the Pennsylvania State normal schools will be examined, and certain results tabulated. It will be seen that the teachers of *arithmetic* and *grammar* far

outnumber those of science. But let the official announcements of the schools speak for themselves.

	No. Students.	Teachers Grammar.	Teachers Mathematics.	Teachers Science.	Remarks.
1st District, - -	800	6	9	1	
2nd " - -	979	2	5	2	Physiology taught by a physician.
3rd " - -	662	2	5	2	
4th " - -		1	1	1	Not yet opened.
5th " - -	360	1	2	1	
7th " - -	360		1	2	The science teachers devote but part of their time to their own dept.
8th " - -	579	2	2	1	Science teacher is also instructor in gymnasium.
9th " - -	666	2	2	1	
10th " - -	711	1	1	2	Assistant teaches history and zoology.
11th " - -	500	1	1	1	The science teacher is also teacher of ancient languages.
12th " - -	530	1	1	1	
13th " - -	526	1	1	1	Science teacher teaches grammar also.
12 schools,	6,673	20	31	16	

By above table it will be seen that for 6,673 students some sixteen science teachers are provided, but in six instances these teachers give instruction in other branches, leaving but ten teachers devoting all their time to scientific instruction. The extreme illustration is seen in the first district, where fifteen teachers instruct in mathematics and grammar to one solitary teacher in science.

If, however, we further examine the catalogues, we find that in the elementary course (which is the only course the great bulk of the students take) the sciences required are physiology and hygiene, elementary natural philosophy and botany. To teach physiology and hygiene to teachers, it might readily be supposed that a person trained in medicine would be demanded, but only *one* such trained teacher is found in the twelve schools. A fair knowledge of elementary natural philosophy is imparted, but the work in botany is abridged to so short a time that it is questionable whether the graduates are able to do much with it when they become teachers themselves.

In the scientific course, which extends over two years, chemistry, zoology and geology are taught for one term each, natural philosophy for two terms. The same criticism is applicable to the scientific work in this course as is made above for the work in botany.

If, from the strictly professional schools we now turn to the academies and colleges, which prepare a large proportion of the teachers of the state, we will find much the same condition of affairs. As a rule, the academies and seminaries can afford but a single science teacher. With the colleges it is but little better, except that largely these institutions have been able to secure two professors for the scientific branches, chemistry and physics being assigned to one, while geology and the organic sciences are given to the other. Pennsylvania has twenty-six colleges for men (part of these co-educational) and eleven for women (Last report of U. S. Commissioner of Education). Of these thirty-seven institutions, the University of Pennsylvania, Lehigh University, the University of Western Pennsylvania, Lafayette College and Bryn Mawr College are the only ones in any wise fully equipped for scientific work. In some cases there are more than two science professors in one institution, but in other cases there is but a single instructor. The writer has not, in his possession, catalogues of all the colleges, and hence cannot make a tabulated statement, as has been done for the professional schools.

The answer then is reached. Scientific instruction in the public schools is a failure because teachers are not trained to impart it. At present, mathematics and grammar are considered of far more importance than science in the training of teachers. How long this state is to continue no one can affirm. The only solution of the problem is better all-round preparation for teachers.

ELECTRICAL COOKING.

Some years ago (in December, 1890) the writer made some experiments with a view to determining the efficiency of electrical cooking, as the general opinion at that time was that any such employment of electricity would be too inefficient to be commercially practicable, and the writer had reason for believing otherwise. These experiments showed conclusively that the use of electricity for cooking was more economical and efficient than the use of coal in an ordinary cooking stove, but, as it was the intention of the writer to take out patents on several points, these results were not published at the time.

Since 1890, the fact of the efficiency and low cost of electrical cooking has been generally recognized, not only theoretically, but also in practice. But although there are now at least a dozen companies engaged in producing electrical cooking apparatus, and their productions are finding their way into hotels, dining cars, steamers, and private houses, so far as the writer knows, there have not as yet been published any tests of the relative efficiency of the new apparatus and the ordinary cooking stove. For this reason the following results may be of interest, the more especially as the results show the truly awful waste of fuel at present taking place, and the direction in which improvement both in heating and cooking must be looked for.

Details of apparatus used in making test. The cooking stove was of the ordinary type, the enclosed grate which holds the fuel being twelve inches long by six inches wide by six inches deep. Area of top of stove, seven square feet. Size of oven, 2x1.6x1.6 feet. Number of orifices on top of stove, six. Orifices eight inches in diameter. A damper is so arranged that the heat passes directly up the chimney, after passing the six orifices for culinary utensils, or may be directed around the oven, after passing two orifices only. The total radiating surface is 37,200 square centimetres, approximately, and the average all day temperature, so near as could be ascertained, nearly 100 degrees C.

The box for electrical heating was a cube whose sides were one foot in length. It was of polished tin, but no attempt was made to render it more bright than it was when bought. The box was heated inside by passing a current of electricity through a coil of iron wire wound inside the box. The watts used in heating could be found by multiplying the current passing through the coil by the difference of potential between its ends, a thermometer inserted in the box giving the corresponding temperature.

The total quantity of coal used in the stove, obtained by taking the average of several weeks, was thirty pounds per day. Taking the average value for the thermal equivalent of good coal, this would represent the production of 100,000,000 calories, and therefore the efficiency will be given by dividing the total number of calories of useful work obtained from the stove by 100,000,000.

We can divide the useful calories into three classes, which we will call the *c*, *r*, and *p* calories, the *c* calories being those actually used in cooking, the *r* calories being those used in raising the water in which the substance is cooked to a cooking temperature, and the *p* calories being those calories used in cleaning the cooking utensils, etc. In the case taken, the *c* calories amounted to approximately 30,000*.

The cooking efficiency, or the ratio of the calories used in cooking to the total watts in the coal, is therefore only .03 (three one-hundredths of one per cent).

The *r* calories amounted to 435,000. Adding them to the *c* calories, we get the total cooking efficiency to be .46 (46 one-hundredths of one per cent).

The *p* calories amounted to 2,256,000 approximately. Adding them to the *c* and *r* calories, we get the total all day ratio of the useful watts to the total calories in the coal to be 2.7 per cent.

The addition of the calories used in heating a hot-water apparatus for baths, etc., adds about 1.5 per cent to the efficiency, making the total all day efficiency of the stove above 4.2 per cent.

The writer has been informed that Professor Tyndall, in a test of the efficiency of a stove, obtained the figure of six per cent. This, however, must have been the maximum efficiency, as, without the hot-water coils (which were probably not in the stove tested by Professor Tyndall) the all day efficiency can hardly reach three per cent.

There remain, out of the original 100,000,000 calories in the coal, about 96,000,000 to be accounted for. These evidently are lost up the chimney or are radiated out into the room. We may make a rough calculation of their relative and absolute amounts.

The total radiating surface is, as given above, 37,200 square centimetres. Taking the average difference of temperature between the stove and the room as eighty degrees C., and taking the coefficient of emissivity of the blackened surface of the stove as .0004, we find for the total loss in radiation, for the day of ten hours, 64,800,000 calories. The remaining 30,000,000 calories must go up the chimney, or be left in the unconsumed coal.

We may tabulate the results thus:

1. Total amount of heat in coal, -	100,000,000 k.
2. Amount used in actual cooking, -	30,000 k.
3. Amount two plus amount used in raising water in which food is cooked to cooking temperature, - - - -	465,000 k.
4. Amount used in cleansing cooking utensils, etc. (2,256,000) plus amounts 2 and 3, - - - - -	2,750,000 k.
5. Amount used in heating bath, approximately, - - - - -	1,500,000 k.
6. Amount used in warming room, -	64,800,000 k.
7. Amount lost up chimney, and through incomplete combustion, -	31,000,000 k.

From these figures we see that the name cooking stove is really a misnomer, for of the total amount of useful work which is got out of the stove, i. e., 69,000,000 calories, only 30,000, or about .04 per cent are utilized in cooking, the rest being spent in warming the room, and in heating water. It will be noticed that cooking stoves seem to be designed to present as much surface for radiation as possible, and that the efficiency of the stove as a water heater is only four per cent, while, with proper design, a water heater should have at least fifty to sixty per cent efficiency.

The efficiency of the electric heater is very simply calculated.

*The c calories were obtained by weighing the food before and after, and taking the loss in weight as due to evaporated water. This, of course, is not strictly accurate, but it must be a fairly close approximation.

A box, whose interior volume is eight cubic feet will cook the same amount as the stove experimented upon. The surface radiating heat will be, in this case, about 24,000 square centimetres, and, taking the emissivity at .00025, we get for the total loss, since the current will be only used six hours, as against the ten of the stove (as no appreciable time is required to warm the electrical oven, and the current may be cut off when not in use) a total of 7,000,000 calories lost by radiation per day, when there is not a heat-retaining covering, such as asbestos, and the bare tin is exposed to the air. It would be only 55,000,000 in actual practice, as one side would rest on a table.

By the use of proper insulation, the loss can be reduced to one-tenth of this, or 700,000 calories. We thus obtain the following table.

1. Amount used in actual cooking, - -	30,000 k.
2. Amount lost in radiation, - - -	700,000 k.
Total cost at 1 cent per 100,000 calories (which is the actual selling price of the electric companies at present, or slightly above it, in some cities)	7.3 cents.

If we include the amount of heat used in heating the food up to cooking temperature, we get,

1. Amount used in actual cooking plus amount used in heating up to cooking temperature, - - - -	465,000 k.
2. Amount lost in radiation, - - -	700,000 k.
Cost at 1 cent per 100,000 calories, -	11.65 cents.

If we include the amount of heat used in heating water for cleaning kitchen utensils, water for bath, etc., we get the following:

1. Amount used for cooking plus amount used for heating to cooking temperature plus amount used for heating water for cleaning kitchen utensils, water for bath, etc.,	4,250,000 k.
2. Amount lost in radiation, - -	700,000 k.
Cost at 1 cent per 100,000 calories, -	42.5 cents.
The cost of the thirty pounds of coal, at $6.00 per ton, is - - -	8 cents.

We see, therefore, from these figures, that, so far as actual cooking is concerned, electrical cooking is about ten per cent cheaper than cooking with an ordinary stove.

When we use the electric stove to heat the water in which the food is cooked to boiling point, we see that electric cooking is thirty-five per cent more expensive, if we take the ordinary prices ruling at present. As, however, a load due to cooking comes at a time of the day when a load is much desired by station managers, and would give a return at a time when the dynamos are practically doing nothing else, it is certain that there would be a deduction from the ordinary lighting rates, and the electric oven would compare favorably with the cooking stove under those conditions.

When, however, we come to use electricity as a means of heating water, for any purpose, we see that the electric cannot hope to compete with the ordinary method, uneconomical as the latter is. We are led, therefore, to the following, as the most economical method.

A boiler for heating water can readily be designed that shall have an efficiency of fifty per cent. This should be used for heating water, and also for heating the house, by means of the ordinary method of tubes. Means of effecting this combination will readily suggest themselves.

The electric oven should be used for cooking.

With this system we get the following table:

1.	Cost of electricity for cooking as above,	7.3 cents
2.	Cost of heating water, for purposes as given above, and the same amount, in boiler of fifty per cent efficiency, with coal at same price as mentioned above, allowing for loss through radiation for day of twelve hours,	1.2 cents
	Total cost,	8.5 cents

It will thus be seen that there is practically no difference between electricity and the ordinary cooking stove, so far as cost is concerned, and it is almost needless to point out the advantages of the electric oven over the cooking stove.

In the first place, we have absolutely no dirt, the electrical oven being lined with porcelain enamel, which can be cleaned with the greatest ease. In the second, we have practically no heat outside the oven to heat the room in summer. Then we have absolute regulation of the temperature. If the oven is cold, and we require a temperature of, say, 100 degrees C. to cook something, the automatic regulator is set to 100, and in less than a minute the temperature has risen, and remains exactly at that temperature. Again, if it is desired to only cook for a certain time, say two hours, the cut-out is set for two hours, and at the end of that time the current is either stopped entirely, or is lowered so as to give any reduced temperature that may be desired.

In conclusion, we may say that the electric oven is bound to come, if only on the score of convenience and accuracy. If cheapness were the only consideration, we should still be burning tallow candles or gas, but people, and especially the American people, will always decide in favor of what is most convenient, so long as the difference in expense is not so great as to form a serious burden, and the above data will, it is thought, show that, used in a proper manner, the expense of electrical cooking need not be seriously taken into account.

It will be seen that of every 100 tons of coal used in a cooking stove, ninety-six tons are wasted. It is difficult of course, to get exact figures, but it is probable that the waste in the city of New York alone is not far from 1,000,000 tons per annum.

With the electric stove, though the cost does not greatly differ, yet by far the larger proportion of the expense is due to the labor, interest on plant, and canalization, so that (taking the efficiency of the boiler, engine and dynamo as ten per cent) the electrical oven, for the same amount of useful calories, uses only one-fourth as much coal as the cooking stove, and from a social-economical point of view, is much to be preferred, for the more we can live on the world's interest, which is labor, and the less we draw from the world's capital of fuel, the better. R. A. F.

MOUSE TRAPPING.

BY FRANK BOLLES, CHOCORUA, N. H.

Late in August the mice of our White Mountain woods, fields, and meadows, begin to show an increasing interest in corn, sweet apples, and other kinds of bait usually used in effecting their capture. In the early summer trapping them is slow work, but the chill of autumn seems to stir them to fresh activity in the gathering of food, and then pursuit of them becomes really interesting. This year I am taking them alive in order to learn more about their habits during the winter. Where, in previous years, I have set the deadly little "cyclone" traps, I am now setting the common woven-wire trap with a revolving wheel attached. For the ordinary white-footed, or deer mouse (*Sitomys americanus*), I have only to bait the trap with kernels of corn or a bit of sweet apple, and place it at sunset near my wood pile or under the lumber heap back of my barn, and the sound of the whirling wheel is soon heard. For the long-tailed, gray, white-footed mouse (*Sitomys americanus canadensis*), I go to pine stumps in the woods, or to the old logs on the shore of a pond far from houses, and feel confident of taking him wherever I have previously found traces of his presence.

It is also easy to capture the short-tailed, brown meadow mouse (*Arvicola pennsylvanicus*), who always seems to me as much like a diminutive bear as the white-footed mouse is like a tiny deer. His place of abode is readily detected, for he makes long runways in the grass leading to the holes in the ground through which he reaches his burrow. Sometimes I find him under a plank bridge which crosses a moist spot on the edge of the mowing land, but oftener I trap him in the long matted meadow grass where his paths lead here and there in search of food or water. As a rule I catch him in broad daylight when he is most active. *Evotmys rutilus* has a keen eye for protective colors. I find him most frequently in dark, damp woods, remote from houses, domiciled in hemlock stumps. His chestnut fur matches the color of a decaying stump so closely that he seems like an animated portion of the red wood. He does not, however, confine himself to the forest, for I have caught at least one of his family, close to my barn. Neither does he limit his range to low land, for I have secured specimens a thousand feet above his favorite swamps.

By far the most beautiful of the New England wild mice is the jumping mouse of the woods (*Zapus insignis*). For him I walk back a mile from my house through lonely pastures and birch woods to a mountain stream which comes splashing over a rocky bed in a dark ravine. It is not on the first, or even the second day, that he condescends, or dares, to enter the trap, although that dangerous engine is carefully covered and disguised with leaves, ferns and bits of growing moss, until it looks like a piece of the wild wood itself. At first he eats the kernels of corn or the pieces of apple which are placed farthest from the trap. Then, night by night, he comes nearer, until at last, having eaten all the corn and apple outside of danger limits, he ventures too far and is caught. Probably *Zapus hudsonius*, the common jumping mouse, is to be found in this vicinity, but thus far I have not secured him, although his cousin with the white-tipped tail might almost be called abundant. A seventh species, too well known in his customary resorts, is *Mus musculus*, the old world pest of the pantry.

Trapping mice in "cyclones" often results in supplying moles and shrews with food which they seem greatly to enjoy. In fact, *Sitomys* himself is only too willing to devour the tender portions of his own kindred. By using the wheel trap and taking my mice alive, I am not annoyed by the flesh-eaters.

SUBMARINE PHOTOGRAPHY.

BY JOHN HUMPHREY, LONDON, ENGLAND.

Several of the difficulties experienced in endeavors to ascertain the natural relations of objects existing at considerable depths under water have been overcome by M. Louis Boutan, in a remarkably ingenious manner, and the contrivances he adopted are described in a recent communication to the Paris Academy of Sciences.

He prefers to use a small camera in which several plates can be exposed consecutively, and encloses this in a rectangular, water-tight metal box, into the sides of which plates of glass are inserted to serve as windows. The camera can be so disposed that the lens may face all the windows in turn, if desired, and exposures are regu-

lated from outside the metal case. To avoid any ill effects that might be caused by differences in the internal and external pressure when the apparatus is sunk in deep water, a kind of balloon filled with air is connected with it. As the pressure increases, in descending, the balloon is compressed, extra air is thus forced into the box, and the pressure on its walls equalized. A stout foot to support the apparatus and weights to sink it complete it for practical purposes.

In water near the shore, not greatly exceeding one metre in depth, the apparatus can be conveniently fixed, without the operator needing to enter the water, and, by direct sunlight, good negatives can be obtained in ten minutes. When the water is deeper the operator must descend in diving costume to fix the case securely on its stand before commencing the actual work of photography. In calm, bright weather photographs can then be obtained by direct sunlight in from thirty to fifty minutes. Colored glasses, preferably blue, must be interposed between the objective and the water, in order to obtain sharp images.

By the use of artificial light to illuminate the surroundings, however, matters are still more simplified. To this end, M. Boutan has contrived a special magnesium lamp. A cask of two hundred litres capacity is filled with oxygen gas, and on its upper end is fixed a spirit lamp, which is covered by a bell glass. A vessel containing magnesium, in powder, is connected with this lamp in such a manner that the metal can be projected across the flame by the action of a rubber ball which serves as bellows. The oxygen gas, of course, is intended to assist combustion, and the lamp, having been lighted and covered by its protecting globe, the cask simply requires weighting to sink it.

Good instantaneous negatives have thus been obtained by M. Boutan during a violent storm, when no daylight could penetrate the depths. They are lacking, as regards background, but this he attributes to imperfections in the apparatus, particularly the objective. He also found it necessary to place before the lens a diaphragm of very small aperture to secure a sufficient degree of sharpness. If a formula were calculated for an objective, the front of which might be exposed to sea water, he thinks these drawbacks might be remedied.

As it is, he has proved that photographs can be taken in a brief time under water, in calm weather, by direct sunlight, at depths up to six or seven metres; whilst, by the use of his special lamp, they can be taken, instantaneously, at any depth that can be conveniently reached by a diver, and the state of the weather is of no importance.

THE SCIENTIFIC BASIS OF COMPOSITION.

BY DR. CHARLES H. J. DOUGLAS, BOYS' HIGH SCHOOL, BROOKLYN.

The end of literary composition is effective communication. To this end there are necessary, first, something to communicate and, second, some means of communication. The only thing to be communicated is thought. The medium of communication is language. One cannot, then, expect to understand the philosophy of literary composition without investigating both the nature and the process of handling both thought and language.

Psychologists recognize three distinct kinds of thought, viz., the concept, the judgment and the argument. The concept, the simplest form of thought, may be defined as the act of mind by which we merely become aware of something. Objectively considered, the concept is indivisible and unrelated—a kind of intellectual atom. The simple judgment, a more complex form of thought than the concept, may be defined as the act of mind by which we apprehend an agreement or disagreement between two concepts. Objectively considered, the judgment is a complex unit, resolvable into its constituent parts—a kind of intellectual molecule.

The argument, the most complex form of thought, is commonly regarded as differing essentially from both the concept and the judgment. It is, however, in the last analysis, nothing else than a complex judgment. It may be defined as the act of mind by which we apprehend an agreement or a disagreement between two concepts, by apprehending an agreement or a disagreement between each of them and a third concept.

The relation of logic to composition is peculiar and quite likely to be misapprehended. The formation of judgments upon a subject must, of course, precede the communication of thought upon that subject. But the formation of judgments upon a subject is nothing else than the study of that subject; it is not composition. That process begins with the selection of judgments already formed; and it ends, so far as the handling of thought is concerned, with the arrangement of them according to a certain recognized principle.

At this point, then, the mind begins a new process. Ceasing, for the moment, to form judgments about the subject of the communication, it begins to form judgments about those judgments in order to the process of discourse. This may be defined as the selection and the arrangement of judgments with a view to the greatest mental effect in apprehending them.

Thus, while the formation of a set of judgments about the subject of the communication, and of another set of judgments about the first set, are both processes implied by the process of composition, neither of them is included in that process. Again, the mind, in the formation of judgments about its own judgments, in order to discourse, is subject to the laws of logic no less than it is in the formation of judgments about the subject of the communication. The relation of logic to composition is, therefore, seen to be both vital and complex.

But, while the mind in the formation of judgments about its own judgments, in order to discourse, is subject to the laws of logic, yet the principles according to which the selection and the arrangement of the judgments are made, are not principles of logic, but of dialectic. This may be defined as the science of effective thought, as logic is the science of correct thought.

So important are the selection and the arrangement of judgments in the effective handling of thought, that it has sometimes been said that what the judgment is to the concept, and what the argument is to the judgment, such is method to the argument; and that, consequently, a fourth division is necessary to complete the doctrine of logic. Both the premise and the conclusion of this statement are, however, untenable.

It is evident that method does not sustain the same relation to the argument that the argument does to the judgment and that the judgment does to the concept, first, because the argument does not sustain the same relation to the judgment that the judgment does to the concept; and, second, because method is of precisely as much importance in simple discourse, where there are no arguments at all, as it is in reasoning, where there is nothing except arguments.

The importance of method, instead of arising from some relation which it is supposed to sustain to the argument, depends entirely upon the principle of the economy of the recipient's attention. By selection, the waste of his energy in the formation of irrelevant or unimportant judgments is avoided. By arrangement, the greater susceptibility of his mind at certain points in the time-series of cognitions which he makes, and to certain sequences of judgments, is taken advantage of.

The process of expression, like that of thought, is conditioned by the physical and psychical nature of man. It is not necessary here to describe the different steps of direct imitation by gesture and cry, of designation from analogy, and finally of imitative and arbitrary graphic representation, by which it is agreed that language was brought to its present high state of efficiency as an instrument for the spoken and written expression of thought.

Those principles of expression that are common to all languages, such as the principles of general grammar and those of rhetoric, have their basis in the nature of the intellectual processes. The principles of general grammar are necessarily the complement of the principles of logic; as the principles of rhetoric are necessarily the complement of the principles of dialectic. The special grammars of particular languages are more arbitrary in their origins, and occupy a position intermediate between general grammar and such purely conventional devices of expression as spelling, punctuation and variation of letter-forms.

The nature of the outline as a process-instrument antecedent to the full thought and its complete expression is not sufficiently understood, even by those who avail themselves of its aid in composition. The utility of the outline is due to the fact that by it we are able to express and contemplate major thought-relations without giving attention to minor ones.

The use of a certain number of visible symbols must be helpful in the process of connected thought; for by thus enlisting the service of the sense of sight, the mind is enabled the more easily to occupy itself with the judgments it has already formed, and accurately to determine their mutual relations. On the other hand, for the same reason, that is, because the mind through the sense of sight is fixed upon them, a great number of words organized into propositions, become a hindrance to that subtle activity of the mind by which, from a chaotic mass of unassimilated elements, organism of living thought is developed.

In order, then, to the most effective thinking about thought, as a process necessarily involved in that of composition, there is requisite a system of symbols which, enabling the mind through the eye to take firm hold of the growing thought, are yet not so numerous or complicated as to hinder their own frequent readjustment, as the subject takes form in the mind. These requirements the ordinary form of the outline, with its brackets and catch-words, effectively supplies.

The cry that composition as it is taught in the schools is a failure is heard on every side. Why are our teachers not more successful in this really fascinating subject? Is it not because they are ignorant of, or indifferent to, the scientific basis of composition, as it has been set forth in this article? Certainly a great reform is called for in the way of far less attention, relatively, given to the trick of juggling with words, and more to the nature and handling of thought. Frightful as the names "logic" and "dialectic" undoubtedly are to the common run of teachers, the subjects they represent not only are harmless in themselves, but lie at the very foundation of effective communication.

THE INTERNATIONAL CONGRESS OF ANTHROPOLOGY.

The International Congress of Anthropology convened at Chicago, Monday, August 28th, and held daily morning and evening sessions during the entire week, closing Saturday, September 2d. All the meetings were well attended, and there was more than a full supply of excellent papers on various branches of anthropologic science, which frequently elicited animated discussion.

The session on Monday was opened by the address of the President of the Congress, Dr. Daniel G. Brinton, whose subject was "The Nation as an Element in Anthropology." It was intended to show the physical, mental, and social changes which take place when man passes from a consanguine or tribal condition of government to that which is national. This transition exerts a profound influence on the physical man through new laws of marriage and relationship, and on religion, ethics, jurisprudence and art through the extension of the intellectual horizon. The goal of such changes, the speaker predicted, will not be reached in nationalism, but in internationalism, and in the supremacy of the individual, as the only proper aim of government. The remainder of the day was taken up with the exhibition of trepanned skulls from ancient Peru, by Senor M. A. Muniz, and explanations of the anthropological laboratories of the Department of Ethnology at the Columbian Exposition, by Drs. Franz Boas, Joseph Jastrow, H. H. Donaldson and G. M. West. The latter offered a paper of great merit on the anthropometry of North American school children, and Dr. Boas one on the physical anthropology of North America, the result of very extended measurements.

Tuesday was devoted to Archæology, principally American. Mr. H. C. Mercer, however, exhibited an artificially flaked stone from the San Isidro gravels, near Madrid, Spain, exhumed by himself, and explained its probable palæolithic character. Professor G. H. Perkins read a resumé of archæological investigations in the Champlain Valley, and Professor Otis T. Mason described in a most interesting manner the mechanical resources invented and developed by the aboriginal toilers of the American continent. The anthropological work at the University of Michigan was sketched by Mr. Harlan J. Smith; Senor Emilio Montes entered a plea for the great antiquity of the civilization of Peru; and Dr. Carl Lumholtz, just back from his explorations among the cave-dwellers in the Sierra Madre of Chihuahua, described their condition and exhibited specimens of their industries. The paper which attracted most attention, however, was that of Mrs. Zelia Nuttall on the Mexican calendar system, in which she presented a highly ingenious theory for the solution of this obscure and famous problem, supporting it with lengthy computations and the opinion of competent astronomers. The afternoon was spent in discussing the collection of games in the anthropological building by Dr. Stewart Culin, Captain J. G. Bourke and Mr. Frank Cushing.

The session on Wednesday was devoted to ethnology. It was opened by a paper by the President, Dr. Daniel G. Brinton, on the alleged evidences of ancient contact between America and other continents, in which he categorically denied that any language, art, religion, myth, institution, symbol, or physical peculiarity of the American aborigines could be traced to a foreign source. Miss Alice C. Fletcher and Prof. J. C. Fillmore presented a joint study of native songs and music of great interest. Mr. Walter Hough exhibited and described bark cloth from various primitive tribes; Mr. G. A. Dorsey related a peculiar observance among the Quichua Indians of Peru; Mrs. French-Sheldon spoke of some curious customs noticed by her among the natives of East Africa; and the Rev. S. D. Peet presented a memoir on secret societies among the wild tribes. The afternoon was spent in discussing the anthropological collections in the U. S. Government Building, Professor O. T. Mason referring to an industrial exhibit based on linguistic stocks; Mr. W. H. Holmes offering a critical study of the development of flaked-stone implements; Mr. Frank Cushing giving the

particulars of a curious Zuni dramatic ceremonial; and Dr. Cyrus Alder reviewing museum collections made to illustrate religious history and ceremonies.

Thursday morning was assigned to folk-lore, and papers were presented by Mr. W. W. Newell on ritual regarded as a dramatization of myth; by Dr. Franz Boas on the ritual of the Kwakiutl Indians; by Mr. J. Walter Fewkes on Tusayan ceremonial dramatization; and by Mr. George Kunz on the folk-lore of precious stones. The afternoon was devoted to the collections of American archæology in the anthropological building under the care of Professor F. W. Putnam, Chief of the Department, who delivered the opening address on the subject. He was followed by Mr. Frank Cushing on the "cliff-dwellers"; by Mrs. Zelia Nuttall on Mexican archæology; by Mr. G. A. Dorsey on South American archæology; and by Mr. E. Volk on cache-finds from ancient village sites in New Jersey.

"Religions" was the subject taken up on Friday morning. Dr. Morris Jastrow, Jr., began with an explanation of the method and scope of their historical study; Mrs. Sarah Y. Stevenson gave an interesting sketch of an ancient Egyptian rite illustrating a phase of primitive thought; Mrs. Matilda C. Stevenson contributed a chapter in Zuni mythology obtained by personal study on the spot; and Mr. F. Parry read a theory relating to certain elements of religious symbolism. The afternoon was given to discussion of various points in North American ethnology by Professor O. T. Mason and to the ethnology of Paraguay by Dr. Emil Hassler.

The last day, Saturday, was set apart for "Linguistics," and for reading papers which had been crowded out on previous days. Dr. Daniel G. Brinton gave a brief review of the present status of our knowledge of American languages with especial reference to the parts of the continent in which it is deficient. These he especially found in Mexico and central South America. Dr. Boas stated his classification of the languages of the north Pacific coast; Dr. C. Abel illustrated his theory of the affinities of the Egyptian and European languages; Mr. Richardson read on the Cameroons of South Africa; Mr. Wildman on the ethnology of the Malay peninsula; and Dr. Jahn on the ethnological collection in the German village at the Fair. The session and the week closed with a social dinner in the Midway Plaisance given by the American to the foreign delegates, presided over by Professor F. W. Putnam and Dr. D. G. Brinton, which closed the scientific proceedings in the most agreeable manner.

All of the papers mentioned above were read before the congress and discussed as far as time permitted. Besides these, a number were read by title from writers who could not be present. Among them were Mr. Horatio Hale, A. L. Lewis, Dr. A. F. Chamberlain, Dr. F. S. Krauss, M. Raoul de la Grasserie, Dr. F. Jacobsen, Senor C. De la Torre, and others.

The number of foreign delegates embraced a fair proportion of those present, and in this respect the Congress merited its title as an "international" one. Among them may be mentioned Dr. Carl Peters, the Imperial German Commissioner for East Africa, Senor Manuel M. de Peralta, Minister from Costa Rica, Dr. Carl Abel, the well-known Egyptologist, Mr. C. Staniland Wake, of London, Dr. A. Ernst, of Venezuela, etc.

It was decided to print at an early date the transactions of the Congress by subscription. They will form a volume of 500 pages, price $5.00, subscriptions for which may be sent to Dr. Franz Boas, Secretary, Department of Ethnology, Columbian Exposition, Chicago.

Frederick Warne & Co. will issue immediately a "Dictionary of Quotations from Ancient and Modern English and French Sources."

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Insect Swarms.

On the evening of June 26th, last, the fire department was called to two of the highest buildings in this city, the alarms being caused by an appearance as of smoke issuing from the pinnacles of the towers. In both cases the appearance was found to be caused by clouds of insects. On the following evening I witnessed the same interesting phenomenon about the court-house tower. I knew that I was looking at a swarm of insects, yet it was difficult to realize that it was not smoke, issuing from the summit, and driven by a brisk breeze. Near the tower the swarm was narrow and dense, gradually widening and thinning to a distance of about fifty feet, where it seemed to vanish by attenuation. The extent of the swarm varied but little during my observation, but the constant changes within it exactly simulated puffs of smoke driven away by the breeze. The deception was still more complete from the fact that the insects swarmed on the leeward side. On other dates up to July 18th I saw the same display, in each instance agreeing in every detail with the above description. The insects appeared to gather just before sunset and probably remained till attracted by the lights of the city.

On a store front near-by I captured some insects which I have good reason to believe were identical with the swarmers. These are Neuropters, about one-half of an inch in length, exclusive of the antennæ, genus and species unknown.

C. D. McLouth.

Muskegon, Mich., Sept. 2.

Prosopophora; a Genus of Scale-Insects New to the North American Fauna.

Some time ago, I found at Las Cruces, N. Mex., a chenopodiaceous plant suffering severely from the attacks of scale insects (Coccidæ). On examination, it turned out that there were three species of these insects present, all new to the fauna of the United States. One is a form of *Mytilaspis albus*, Ckll., known hitherto only from Jamaica; the second is *Ceroplastes irregularis*, Ckll., the description of which, from Mexican specimens, is about to be published; and the third, to my surprise, proves to be a new species of Mr. Douglas's genus *Prosopophora*.

The genus *Prosopophora* was established in 1892 (Ent. Mo. Mag., August) for a species found on orchids in Demerara, which superficially resembled a *Lecanium*, but was distinguished by a number of peculiar characters. This year (Trans. N. Z. Inst.) Mr. Maskell has described two more species of the genus, found in Australia on *Acacia* and *Eucalyptus* respectively. Now we have a fourth from the United States,—so that within a little more than a year four species have been discovered of a remarkable genus, which had been altogether overlooked until 1892!

Mr. Maskell has kindly sent me both his Australian species, and I have the Demerara one from Mr. Newstead. Our insect is most like *P. acaciæ*, Mask., in appearance and color, but it is amply distinct in its structural characters. I propose to call it *P. rufescens*, and the following short description includes its more important characters: *Prosopophora rufescens*, n. sp. Scale waxy, about 4 to 4½ mm. long, shape and outline of *Lecanium hesperidum*, with a slight but distinct median keel, and a subdorsal row of raised points on each side. Posterior end with a small oval orifice, as in *P. acaciæ*. Surface obscurely granular

hardly shining; color pale red-brown, varying to whitish. Female with very numerous waxy filaments projecting from the surface; gland-orifices minute, circular. Antennæ 8-jointed, the last joint very short, and bearing a few straight hairs, as in *P. dendrobii*. Third joint variable, sometimes rather longer than the second, sometimes decidedly shorter. Legs absent. Anal ring apparently without hairs, but with a strong chitinous projection on each side. Mouth-parts well developed.

On boiling the insects in soda, the scale was entirely dissolved, and the insects became colorless and transparent.

T. D. A. COCKERELL.

Agricultural Experiment Station, Las Cruces, New Mexico, Aug. 29, 1893.

A SMALL TRAGEDY.

IN contrast to the "snake story," given in *Science* (Jan. 20, '93), the following incident may be of interest:

Several months ago a small spotted snake was captured and placed in the "snake box;" it is thought to be a common "milk snake," and is, perhaps, twelve or fourteen inches in length. It was somewhat injured when captured; the boys say its back was broken. It is quite evident that it was hurt, from the depression or deformity at one point, and, from this portion to the extremity of the body, it had great difficulty in shedding its skin. For days and days it was, as it were, half dressed, or undressed, as we may choose to consider this condition.

A few days ago another snake was placed in the same box—what kind it was I am unable to say—but it was a small (not more than eight or ten inches, in length), agile, quite slender little thing, of a plain slate or dove color.

What was our surprise when it was discovered that the spotted snake was in process of swallowing the smaller one. It was horrible, and yet we could not refrain from observing it. In a very short time the little snake entirely disappeared, even to the tip of the tiny tail, and the spotted snake appeared to have enjoyed the meal. The boys claim that it has eaten several small toads; it is now in company with a snake considerably larger than itself. They seem disposed to be "friendly," thus far, and no doubt enjoy each other's society.

MRS. W. A. KELLERMAN.

Columbus Ohio.

THE CACKLE OF HENS.

IT is claimed that the cackling of hens "is very liable to attract the attention of any ovivorous bird or beast to the probable presence of an egg."

It is quite probable that ovivorous birds or beasts may understand that the hen's cackle is the announcement of the presence of an egg, but the hen is wise even in her apparent imprudence. She lets it be known that an egg is somewhere, but she does not tell where. How many, many times she sends the farmer's wife or children on a hunt for eggs they fail to find. Of course, when hens are well cared for, and ample and sufficient nests are provided, they lose their cautiousness, but when they are left to take care of themselves they will "steal" their nests, as the people say; that is, they will go off in the weeds, or seek some sheltered spot, and there make a nest. When an egg is laid, in a "stolen," nest, the hen makes a quick run, quite a distance from her nest, before she makes a sound, so that her cackle would not discover her eggs to any enemy, for one gropes, as in the dark, in search of stolen nests, no matter how loud may be the cackle.

MRS. W. A. K.

Columbus, Ohio.

THROWING STICKS.

I HAVE just made a discovery that has given me great pleasure. In the Anthropological Building at the World's Columbian Exposition is a Cliff Dweller's Exhibit, exposed by the State of Colorado. Other loan exhibits are in the building from that region, and outside is an attractive realistic representation of the industrial products of the same people. In looking carefully through the Colorado State alcove I discovered two examples of the Mexican atlatl or throwing stick. The shaft is a segment of a sapling of hazel wood. At the distal end is a shallow gutter and a hook to receive the end of a spear shaft. At the proximal end or grip, in the more perfect specimen, about four inches from the extremity is a loop on either side of the stick, one for the thumb, the other for the fore-finger. The remaining three fingers would be free to manipulate the spear shaft. These loops were made by splitting a bit of raw hide, sliding it down the proper distance on the

stick, forming loops less than an inch in diameter by bringing the projecting ends of the rawhide and seizing it fast to the shaft. Just below these finger loops or stirrups were a long chalcedony knife or arrow blade, the tooth of a lion and a concretion of hematite seized by a plentiful wrapping of yucca cord. If the readers of *Science* will recall the Bourke example from Lake Patzcuaro, with its long, barbed spear with shaft of cane, he may follow me further and believe that a bit of cane and a spear head of chalcedony attached to a tang or foreshaft of wood lying in the same case, and pointed out to me by Mr. C. C. Willoughby, belonged to the same outfit. This is the first instance of finding the ancient atlatl, figured in the codices and described by Mrs. Nuttall. It also connects the Cliff dwellers with the Mexican peoples.

O. T. MASON.

Sept. 3, 1893.

WATER ANALYSES.

FEAR of cholera has caused waters to pour in floods into some of the analytical laboratories of Europe, and it is more interesting than reassuring to observe the methods followed in dealing with this accumulated work.

In the laboratory of one public analyst, the writer saw a large collection of water samples, as yet unopened, from various localities.

These samples, some of which were weeks old, had been collected in a variety of vessels, principally claret and whiskey bottles, and the corks employed were often old ones.

When one considers the excessive care required for water sampling, the thought that the above lot were doubtless taken by inexperienced hands, with the aid of vessels certainly old and probably unclean, does not increase one's faith in the value of the analytical results.

Much to my surprise, I also saw in one laboratory the old writing-paper packing for connecting the retort with the condenser, a method of union long since discarded for something more reliable. It is so easy a matter to ruin a water analysis by indifferent attention to the proper setting up of the apparatus for the "albuminoid ammonia" process that modern practice discards, as inefficient, several recommendations made by Wanklyn, the originator of the method, and among them the paper packing mentioned.

In short, without wishing to be over-patriotic, my observations here lead me to the belief that Americans do not have to go abroad in order to gather information as to the most suitable methods for making an examination of potable water.

WILLIAM P. MASON.

Stuttgart, Germany, Aug. 9.

THE New York Shakespeare Society has begun to reprint, in its Bankside edition, the archaic texts of the seventeen plays first printed in the Heminges and Condell Folio of 1623. The first of these plays, The Tempest, will leave the press in a few days. Of these new volumes but 500 copies are printed, as before, hand numbered to correspond with the 500 sets of the prior twenty volumes, with which they are of course uniform in style, size, price, etc.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For a rare chance to get a first-class microscopical outfit write for full particulars to box 125, Sellersville, Bucks Co., Pa.

For sale or exchange.—A fine collection of Lepidoptera, native and exotic. For particulars address Addison Ellsworth, Binghamton, N. Y., care Republican.

For sale or exchange for works on entomostraca, Wolle's "Desmids of the U.S.," Hentz "Spiders of the U.S.," The Amer. Entomologist & Botanist, Vol. 2, The Amer. Entomologist, Vol. 1, Harris's "Insects Injurious to Vegetation," colored plates, copy formerly owned by Townend Glover. C. Dwight Marsh, Ripon, Wis.

"The Conchologist: a Journal of Malacology," Vols. 1 and 2, with wood cuts and plates, value 12 [-will exchange for any works or pamphlets on American Slugs or Anatonry of American Fishes. W. E. Collinge, Mason College, Birmingham, England.

Exchange—The undersigned is desirous of obtaining correspondents interested in macro-lipidoptera, in Alaska, the far Western, Southwestern and Southern States. Will also exchange rare lepidoptera for entomological literature. Levi W. Mengel, Reading, Penn.

Wanted to exchange—Medical books, Obstetrical Transactions, London, Works of Sir J. Y. Simpson, Beck's Medical Jurisprudence. Handbook for the Physiological Laboratory, by Burnton, Foster, Klein and Sanderson, Quain's Anatomy, and about fifty others. Catalogues given. Want Geological, Botanical and Microscopical books in exchange. Dr. A. M. Edwards, 11 Washington St. Newark, N. J.

Wants.

FOR SALE.—Volumes V. and VI. of the "Explorations for a Railroad Route from the Mississippi River to the Pacific," 1857, half calf, in good condition; a large number of colored and uncolored plates of Mammals, Birds, Fish, etc., etc. On receipt of $7.00 will send to any ordinary point in the U. S., express paid. These volumes are now rare. Address Dr. Shufeldt, Takoma Park, Dist. of Columbia.

A YOUNG woman who has been an assistant for a literary and scientific man desires a similar position. Is an experienced and accurate stenographer and typewriter, thoroughly educated, and sufficiently familiar with literary work to write, independent of dictation. Has some knowledge of the Spanish language. Will go to any part of the United States. Address, Box 147, Ravenna, Ohio

A GRADUATE of an American Polytechnic institution and of a German University (Gottingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 757 Cary St. Brockton, Mass.

WANTED.—A position as teacher of Biology, by an experienced teacher, a college graduate with four university post-graduate courses in the Sciences. Good endorsements, and eighteen years' experience. Address A. N. Somers, La Porte, Ind.

WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.